NOTES ON NEMATOPHYTON CRASSUM.

BY

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(With Plates XV–XVIII.)

In a former paper* I had the occasion to describe certain fossils from the middle Erian of New York, and referred them to *Nematophyton crassum*, Pen., although originally described by Sir William Dawson under the name of *Celluloxylon primævum*. This transfer was based upon indirect evidence and was regarded by me as requiring confirmation. It was, therefore, a matter of special congratulation when, during the past winter, fresh material was placed in my hands, which seemed to substantiate the correctness of my original determination.

In January last (1892) Prof. F. H. Knowlton, of the U. S. National Museum, informed me that new specimens of *N. crassum* (*Celluloxylon*) had been found in New York, and later transmitted three slides of sections, together with the stem from which they were taken, and also a slide of the type specimen of *Celluloxylon*. This latter was, therefore, from the same specimens as those originally described by me and upon which Sir William Dawson based the genus of that name. Additional comments upon this are not called for at this time, but reference should be made to my former description of its structure.

The other specimens forwarded by Prof. Knowlton were collected by Mr. C. S. Prosser, of the U. S. Geological Survey, from the Cooley Quarry on the southern extremity of Skunnemunk Mountain, Orange County, New York. According to information received from Mr. Prosser the horizon is to be regarded as in all probability middle Erian. It agrees, therefore, in its position, with that of *Celluloxylon*, which was obtained from the Hamilton Group in Hopewell, near Canandaigua.

The section of stem measures about 3 inches in diameter and shows no external evidence of structure beyond a band of prominent, longitudinal striæ on one side, and detached masses of carbonaceous matter on the opposite side. From this specimen three slices were cut in such a manner as to represent as nearly as possible the three usual directions of section. I shall, therefore, distinguish them by the usual terms.

* Trans Royal Soc., Can., VII. iv, 23.

TRANSVERSE SECTION.* $\frac{114c}{558}$

The transverse section as a whole shows considerable diversity of structure, obviously due to alteration in the process of decay and the subsequent formation of siliceous crystals. In one part the cell walls and all cell cavities are sharply defined. The cells are fairly uniform in size, ranging from 23 μ to 46 μ, with an average of 34 μ. The walls are very black and 3.8 μ thick. The cells are, as a rule, rather remote, being distant 3.8 μ to 49.1 μ, thus giving to the structure, as a whole, a very loose, open character. There is very rarely an indication of intercellular filaments where now and then a large one, running transversely, has survived the otherwise general disintegration of the hyphæ. All the intercellular spaces are occupied by a fine cellular appearance, due to the disposition of a very thin layer of the altered carbonaceous substance upon the surfaces of small crystals of silica.

In the other parts (see Fig. 7), $\frac{114c}{558}$, the large round cells are obvious, but the walls have become thickened in an irregular manner and have lost their sharp outlines in a marked degree, while they are commonly connected with one another by coarse lines of carbonaceous substance in such a way as to make the intercellular spaces appear like large and imperfectly formed parenchyma cells with irregularly thickened walls. All the intercellular spaces are occupied by a mass of fine crystals, having the appearance of a very fine cellular tissue.

In yet a third area (see Fig. 5), $\frac{114d}{558}$, the round cells of the first have almost absolutely disappeared. Only here and there can a trace of one be found. They have been wholly replaced by typical *Celluloxylon* structure, indistinguishable from that found in the original type specimens of that genus. That these three conditions do not represent normal structures is at once obvious from the transitional conditions to be found within the same section.

RADIAL ? SECTION ($\frac{115}{557}$).

In this the *Celluloxylon* structure is very prominent. In many places it shows derivation from tubular cells, the position of these latter being very obvious under a low power. As in the transverse section, there is no evidence of intercellular filaments. Rarely, obscure indications of open areas are met with.

TANGENTIAL ? SECTION ($\frac{116}{559}$).

The general structure is the same as in the radial section except that we here meet with well-defined evidence of open areas. These are irregular in form, somewhat numerous, and filled with a mass of very fine crystals of silica, about which carbonaceous matter has been deposited,

*The numbers given refer (numerator) to my laboratory number and (denominator) to the number as given in the collection of the U. S. Geological Survey.

so that the whole presents the aspect of a very fine cellular tissue similar to that which is found occupying the intercellular spaces of transverse sections. Into these open areas the large tubular cells are found to project in a vermicular manner, precisely as in perfectly preserved specimens of *Nematophyton Logani* and other species examined by me. The tubular cells are in no case perfect, but sufficiently so to indicate their original character. No evidence of intercellular filaments could be found.

Comparing these specimens with the type of *Nematophyton crassum*,* we find they agree with it in all respects except the absence of intercellular filaments from the former and their presence in the latter. But this difference may safely be attributed to the operation of greater alteration in one case than in the other, and it is therefore admissible to consider that my reference of *Celluloxylon primævum* to *Nematophyton crassum* was not only correct, but that it receives striking confirmation from these specimens.

It may also be well to place on record a few observations made during my examination of this material, as bearing upon the alteration of organic structure by decay and crystallization.

The extent of alteration appears to depend in the first instance upon the extent of decay in the organic structure at the time when crystallization of the infiltrated silica becomes pronounced, and thus upon the conditions favorable or adverse to freedom of growth in the crystals. This is clearly shown by the transitional forms of the structure as already described, which, in turn, also show that the imperfect tubular structure seen in longitudinal section and the large parenchyma-like cells of the typical *Celluloxylon* are derived, not from the tubular cells of the original structure, but from the spaces surrounding and lying between them; that is to say, crystals or groups of crystals form in the intercellular spaces and, finally, in the cell cavities in such a way as to crush the tubular cells into shapeless masses of carbon, which afterwards become more or less broken up or remain as large and irregular masses of carbon at the angles of the *Celluloxylon* cells.

Three stages in the conversion of the normal structure may be noted:

(*a*) Conversion of the intercellular hyphæ, the medullary structure remaining largely intact. This results in the formation throughout the intercellular spaces and in the open tracts of a fine *Celluloxylon* structure, due to the aggregation of numerous small crystals of silica, upon the surfaces of which the carbonaceous products of decay are deposited. This gives to the present specimen the peculiarities of structure which distinguish it from the typical *N. crassum*.

(*b*) Conversion of the intercellular hyphæ and partial conversion of the medullary structure the tubular character of which is nevertheless evident. There is also in this condition a partial formation of the

*Trans. Royal Soc. Can., VII, iv, 25, Pl. I, Fig. 5.

typical *Celluloxylon* structure, as determined by the development in the intercellular spaces of very large crystals or small crystals which arrange themselves in groups of corresponding size.

(*c*) Complete conversion of all the organic structure, which is now replaced by the typical *Celluloxylon* structure. Here the filaments of the medulla are broken up both transversely and longitudinally in such a way that the resulting *Celluloxylon* cells form long series occupying the intercellular spaces and having the aspect of vermicular filaments similar in position to those of the medulla, but having a considerably greater diameter. Between these three principal conditions all degrees of transition are to be noted.

EXPLANATION OF PLATES.

Plate XV.

Fig. 1. Section from type specimen of *Celluloxylon primævum*, showing characteristic structure. × 151.

Fig. 2. Section of *Nematophyton Logani*, showing typical *Celluloxylon* structure. The same preparation exhibited typical *Nematophyton* structure. × 151.

Plate XVI.

Fig. 3. Section of *Nematophyton crassum*, showing large cells of medulla, intercellular filaments, and an open area. × 151.

Fig. 4. Longitudinal section of the type specimen of *Celluloxylon primævum* from Prof. Knowlton, showing the disposition of the crystals to conform to the position of the tubular cells of the original structure. × 50.

Plate XVII.

Fig. 5. Transverse section of *Celluloxylon* $\frac{114a}{558}$, showing characteristic structure, but the carbonaceous matter very much massed. Also showing remnants of occasional cells of the original structure. × 100.

Fig. 6. Transverse section from the same slide as the preceding, showing normal structure of the large tubular cells, but replacement of the intercellular filaments by fine crystals. Also showing an open area. $\frac{114a}{558}$ × 100.

Plate XVIII.

Fig. 7. Transverse section from the same slide as the two preceding, showing conversion of the normal structure into *Celluloxylon* structure. $\frac{114c}{558}$ × 100.

Fig. 8. Longitudinal section, showing the tendency of the crystals to form along lines conformably to the original structure, and thus essentially the same as in Fig. 4. $\frac{115a}{557}$ × 50.